Legal aspects of climate change adaptation

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Chapter 11
Legal Aspects of Climate Change Adaptation

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Abstract This chapter provides an overview of the current state of affairs with regard to the legal aspects of adaptation to climate change. After a brief introduction into the relationship between adaptation and law, I will discuss the international legal obligations with regard to adaptation that exist under the umbrella of the UNFCCC. The remainder of this chapter will show the impact of adaptation on the fields of law involved, particularly law related to marine and coastal adaptation, water management, biodiversity conservation, planning and land use and buildings and infrastructure, energy and telecommunications, and migration. In fact, there are hardly any policy fields and associated laws that are not impacted by climate change. The big question that arises is whether all of the pieces of legislation associated with these policy fields are suited to facilitate adaptation measures. Is, perhaps, adaptation of the law required, and, if so: what needs to be changed?

11.1 Introduction

Climate change is here to stay, at least for the time being. Even halting all greenhouse gas emissions today (which, of course, is highly unlikely) would only lead to first observable changes for the better after 30–40 years. So we have to adapt to the changing climate. The Working Group II report of the Intergovernmental Panel on Climate Change (IPCC) concludes that adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past

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emissions. For some impacts, namely those that already show or will show in the very near future, adaptation is *the only available and appropriate response*, according to the IPCC.[1] Such impacts for instance are:[2]

- increased water availability in some regions, and
- decreased water availability and increasing drought in others
- increased ecosystem changes (species shifting their natural range) and risk of extinction of species
- negative impacts on a small scale for poor farmers and fishers
- increased damage from floods and storms
- increased burden from malnutrition and infectious diseases and a changed distribution of some disease vectors such as the mosquito's vectoring malaria dengue.

The drafters of the 1992 UN Framework Convention on Climate Change (UNFCCC) treated mitigation and adaptation as equally important. The UNFCCC mentions adaptation as one of the policies and measures to mitigate the adverse effects of climate change in Article 3(3). Under the commitments listed in Article 4 of the UNFCCC, several deal with adaptation. Adaptation, however, received much less attention than mitigation in the 20 years that followed the signing of the UNFCCC. This not only goes for policy and legal measures taken on the basis of the UNFCCC and regional and national implementation thereof, but also for academic research.

Perhaps the lack of attention is one of the reasons why adaptation measures are still in their infancy. It appears to be much more difficult to devise and implement adaptation policies than it is to devise and implement mitigation policies. Partly this is due to the fear that attention afforded to adaptation measures will make it more difficult to get mitigation measures adopted and implemented. Partly, the problem with adaptation is that you cannot always take one-size fits all measures. Some of the consequences of climate change, particularly sea level rise, are similar in all regions of the world. Mostly, however, the consequences of climate change may dramatically differ from one region to another. Some regions suffer from droughts, whereas others face increased floods. This may even be so within one country, such as is the case for instance in large countries such as the US, China and Australia. It may even be so that within the same region, periods of extreme droughts are followed by a period of intense rainfall causing floods. The biggest problem, however, is an inherent difficulty of adaptation law and policy. Whereas mitigation measures primarily can be implemented in one policy field (that of environmental law), adaptation measures have to be implemented through a wide range of policies such as water, marine and coastal, fisheries, biodiversity, energy, building and construction, agriculture, telecommunications, infrastructure, etc. It requires an immense, coordinated effort, to adapt all the policies and laws in these fields of government in such a way

[1] Neil Adger et al., "Summary for Policymakers", in Martin L. Parry et al. (eds), Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge and New York: Cambridge University Press, 2007), 18.

[2] Ibid., see Table SPM-1 of the WGII summary for policymakers, at 15.

that society at large will be prepared for the climatic changes and associated extreme weather events that we are going to experience in the course of the twenty-first century, with a peak expected between 2050 and 2080.

This chapter provides an overview of the current state of affairs with regard to the legal aspects of adaptation to climate change. After a brief introduction into the relationship between adaptation and law (Sect. 11.2), I will discuss the international legal obligations with regard to adaptation that exist under the umbrella of the UNFCCC (Sect. 11.3). The remainder of this chapter will show the impact of adaptation on the policy fields and the related laws involved. There are hardly any policy fields that are not impacted by climate change. Hence, adaptation measures in these fields are required. The big question that arises is whether all of the pieces of legislation associated with these policy fields are suited to facilitate adaptation measures. Is, perhaps, adaptation of the law required, and, if so: what needs to be changed?

11.2 General Introduction to Adaptation Law

11.2.1 What Is Adaptation?

Adaptation is generally, quite loosely, defined as the process of adjusting to climate change and its impacts.[3] This definition is sometimes criticized for its somewhat reassuring connotation.[4] Species, including humans, have always adapted to changes in their natural environment, and the human species has proven to be particularly good at that. "We are found in a wide diversity of physical environments and thrive under a range of climatic characteristics", even though, "in geological terms, the human presence on the Earth has been exceptionally brief".[5] Adaptation to climate change, however, is different from what we are used to because, among others, the changes that are occurring now cannot be considered to be natural, are very complex and diverse and are not just gradual changes, but may be sudden, drastic changes as well. Therefore, there are ecological, individual and cultural limits to adaptation.[6] Hence, it is sometimes concluded that we should not talk "just" about

[3] Ben Orlove, "The Past, the Present and Some Possible Futures of Adaptation", in W. Neil Adger, Irene Lorenzoni and Karen L. O'Brien (eds), *Adapting to Climate Change. Thresholds, Values, Governance* (Cambridge: Cambridge University Press, 2009), 131.

[4] Ibid, at 131–163.

[5] Donald R. Nelson, "Conclusions: Transforming the World", in W. Neil Adger, Irene Lorenzoni and Karen L. O'Brien (eds), *Adapting to Climate Change. Thresholds, Values, Governance* (Cambridge: Cambridge University Press, 2009), 491.

[6] W. Neil Adger et al., "Adaptation now", in W. Neil Adger, Irene Lorenzoni and Karen L. O'Brien (eds), *Adapting to Climate Change. Thresholds, Values, Governance* (Cambridge: Cambridge University Press, 2009), 1.

adaptation, but about "transformational changes", that require us to reform the basis on which we think about the world.[7]

Although it is debatable whether we are doing just that when discussing legal aspects of climate change adaptation, I do feel that lawyers are not underestimating the changes that are necessary to our legal system to facilitate and accommodate the necessary adaptation measures. Let us just have a brief look at the measures that are suggested in, what probably is the most advanced adaptation plan that exists today, the 2010 report by the New York City Panel on Climate Change (NYPCC). This plan gives a good overview of the measures that should be taken in a modern metropolitan area like New York City. They include, for instance[8]:

- Zoning, environmental, water and waste regulations to manage precipitation, flooding and stormwater, to ensure sustained water supply and to protect wastewater infrastructure;
- Zoning and land use regulations dealing with sea level rise and storm surges;
- Laws and regulations aimed at facilitating increased energy demand during heat waves and designating public buildings that can serve as emergency cooling centers in heat waves;
- Laws and regulations enabling the development of new power generation resources, and encouraging siting of emergency power generators to supply energy when there is a peak in demand (during heat waves) or in case of a weather induced electric outage;
- Laws and regulations requiring upgrading underground energy and telecommunications infrastructure to withstand flooding and sea level rise;
- Various environmental impact assessment regulations requiring assessment of the consequences of the proposed activity on adaptation to climate change;
- Amending energy, building, and sewer codes to adapt buildings to high wind conditions, flooding, and high temperatures;
- Requirements on green or energy-smart landscaping, leading to energy consumption reductions in buildings, storm water retention and tree shading;
- Requirements on adapting the transportation infrastructure to deal with flooding, saltwater damage, increased power demands and power outages, overheating of subway platforms, increased stress on infrastructure because of higher temperatures;
- Air quality requirements dealing with more frequent periods of elevated concentrations of ground-level ozone, as well as elevated ozone concentrations;
- Requirements on waste management sites and brownfields to prevent containment leaking in case of flooding and sea level rise.
- Improving laws and regulations concerning emergency preparedness to be able to deal with storm surges, inland flooding and heat waves during summer.

[7] Nelson, supra, note 5, at 497.

[8] As discussed by Edna Sussman et al., "Climate Change Adaptation: Fostering Progress Through Law and Regulation", 18 *N.Y.U. Environmental Law Journal* (2010), 55.

This list just deals with the specific situation in New York City. Other cities around the globe will face other challenges. Coastal defense systems may have to be reinforced or even re-created from the start, for which land reclamation may be in order or expropriation of current land owners; negative impacts on coastal habitats will have to be minimized or mitigated. Parts of a city may even be moved to floating platforms. Other cities may not have the capacity and funds to adopt the kind of the measures New York City is adopting and may have to divert to much more drastic measures such as abandoning parts of the city or the entire city altogether. The same goes for rural areas that are below or on sea level or rural communities that have to cope with increasing droughts in addition to other stresses such as extreme poverty, land degradation, or a large number of HIV/AIDS infections. Bangladesh and parts of southern Africa are the cases in point for situations like this. Mass displacement and mass migration both internally and across border are direct consequences, which in turn may lead to food shortage, lack of adequate housing and jobs, violence between migrants and the existing population. Current international refugee law clearly is not equipped at all to deal with these so called climate refugees and their problems.

Outside of the city, a wide range of adaptation measures are indeed necessary. In order to protect biodiversity, policies should be aimed at making protected areas climate proof by making sure that these areas are large, robust, stable and interconnected enough to adapt to the changing climate. Protected areas should be able to live through occasional flooding, wild fires, and extreme weather events, such as heavy storms. They should have enough variety in habitat types to host new species in search of a more suitable new climate zone. Current biodiversity law, both at the domestic and at international level, is hardly able to provide for these kind of measures. In addition, in most legislatures, biodiversity law is aimed at specific "flag species". As a consequence of climate change, though, species are appearing and disappearing within just a few years, rendering the idea of having a specific flag species for a certain site useless.

Measures in the field of planning law and water law may be necessary to deal with the increased risk of inland flooding. Lands may be designated to serve as controlled flooding areas (or flood control reservoirs) to protect more sensitive parts of the land against flooding. Land may also have to be designated for fresh water storage, so as to have buffer capacity in times of drought. In those regions with increased winter precipitation and increased risk of drought during summer, such as will be the case in northwestern Europe, farmers may have to store fresh water on their agricultural lands in winter, to be used in summer. It is obvious that here, agricultural policies and water policies are closely interlinked, as water in controlled flooding areas, which often are agricultural lands, can be used for this purpose. Farmers may even engage in recreational activities in summer with water thus stored on their lands.

The agricultural sector also will have to adjust crop variety depending on the changing climate and weather conditions. In those areas of the world where local

agriculture is essential for local food production, the government will have to intervene in order to keep or restore food security. The kind of measures that have to be taken vary greatly throughout the world. Farmers may have to shift to crops that are better suited in a wetter, or dryer, or warmer climate, or crops that are better suited in an environment of increasing salinity. More or less the same goes for the forestry sector. The fisheries sector will have to get used to regular adjustments of fish quota due to climate change induced decreased fish stocks. The surplus of water on agricultural lands described above, may foster the introduction of aquaculture on agricultural lands.

Planning law and building law are among the fields of law that are applied by government authorities seeking to reduce potential harms from wild fires in those areas that are prone to increasing risks of bush fires.

Climate change is not only impacting government policies in the fields mentioned above, but also has a direct impact on private actors and thus on private law. Insurance companies are assessing the consequences of climate change for their line of business, the tourist industry is shifting its focus to new, yet to be developed areas, and law firms are setting up climate litigation divisions as the number of law suits is likely to increase with the increasing damage by climate change and with increasing adaptation costs. With the increase of court cases, it is clear that litigation law, insurance law, and even property law is affected by climate law and is, in a way, adapting to climate change as well.

We can, therefore, conclude that climate change adaptation necessitates a thorough revisiting of the law as it is. A transformation of the law is necessary, as much as a transformation of societies as a whole.

11.2.2 Links Between Adaptation and Mitigation

Adaptation cannot be regarded in isolation from mitigation. Not only are both important elements of any climate change policy, they also are positively and negatively interlinked. First, many adaptation measures equally serve mitigation goals. Afforestation, reforestation, preserving and restoring mangroves, with the goal to protect the land against flooding, against landslides following intense rainfall, or against negative impact of storms, are all measures that can as well be part of a mitigation strategy. The same goes for adaptation measures in the field of biodiversity conservation. Creating corridors between protected areas, and enlarging protected areas through restoration leads to an increase in vegetation, and thus to additional carbon uptake. This is even true for the construction of green buildings and green roofs: not only are they naturally cooler and thus an effective measure against heat waves, they also lead to less energy consumption and, again, to additional carbon uptake. In fact, any measure to reduce the amount of energy consumption to avoid an energy fall out during heat waves is a mitigation measure as well.

The second link between adaptation and mitigation is a negative one. Adaptation measures can be harmful to the climate in the sense that they lead to a) more greenhouse gas emissions, or b) a reduction of carbon uptake. The examples are obvious. Installing air conditioners to combat the heat lead to more energy consumption and thus, if the energy comes from a coal fueled energy installation, to higher emissions. Replacing a natural coastal habitat by a large seawall to combat sea level rise and storm surges, leads to a loss of natural carbon uptake. This example, coincidentally, shows that an adaptation measure in one policy field may be detrimental to adaptation policy in another field, as this large seawall that replaces natural coastal habitat probably will lead to a loss of biodiversity adaptation opportunities.

Mitigation measures, on the other hand, can be harmful for adaptation as well. Afforestation in arid and semi-arid regions strongly reduces water yields and thus has a negative impact on local agriculture and biodiversity. Switching to hydropower may reduce irrigation options for farmers and thus deprive them of adaptation opportunities.

It is clear that adaptation and mitigation policies have to be developed together, so that they are mutually beneficial.[9]

11.2.3 Dealing with Risks and Uncertainty

Although thousands of scientists around the globe have been researching climate change for many years now, we still are faced by many uncertainties. Uncertainties as to the exact nature and intensity of the changes that we can expect, the timeframe within which they are to be expected, and the locations that will be hardest hit. Uncertainties present themselves in two ways: (a) uncertainties caused by our lack of knowledge, and (b) uncertainties caused by randomness inherent to the phenomenon at hand. In literature on risks, these are usually described as epistemic risks (a) and aleatory risks (b). Both types of risks are relevant in climate adaptation law and policies.

Obviously, risks inherent to the randomness of floods, storms and other events influenced by climate change will never disappear. We can only predict that in certain areas storm intensity will increase, rainfall will increase etc., without being able to tell exactly when and where a storm will hit and how strong that storm will be.

Uncertainties as a consequence of a lack of knowledge do gradually become smaller because of increasing scientific knowledge as to what is happening to atmospheric and climatic processes due to higher levels of greenhouse gases in the

[9] See extensively chapter 18 of the IPCC's Working Group II report: Richard J. T. Klein et al., "Inter-relations between Adaptation and Mitigation", in Martin L. Parry et al. (eds), *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge and New York: Cambridge University Press, 2007), 745, at 745–777.

Earth's atmosphere. We must, however, not be so optimistic as to think that this type of uncertainty will eventually disappear altogether, at least not in the foreseeable future. Our lack of knowledge still is quite large, especially because as a consequence of climate change, *everything* is changing. Increasing carbon emissions lead to temperature rise, which leads to a great number of subsequent changes in weather patterns. Many of these changes probably do not occur in a linear way. Instead, it becomes increasingly clear that there are many tipping point effects and non-linear effects. Such effects are much more difficult to predict. Paradoxically, increasing scientific knowledge thus has lead to an increase in the epistemic risks. We now better know what we do not know. Our lack of knowledge also concerns the effect of these changes on human behavior and on that of the other living organisms on Earth. How are living organisms, including human beings, going to adapt to these changes once they occur, gradually or suddenly? In addition to all of this, we should keep in mind that scientists will keep disagreeing on certain aspects of their findings. This is simply what scientists do: they question findings in order to establish a theory on the basis of which the most accurate predictions can be made. Policy makers have to deal with this "tug of war among competing theories and qualifications of theories."[10]

Kleindorfer shows how both types of risks are tightly intertwined with choice. A homeowner or a business might consider options such as insurance or mitigation before the fact in order to either reduce or pay for losses resulting from an extreme weather event. In order to reach such a decision, the homeowner of business may want to gain knowledge to reduce the epistemic risk. Knowledge thus is a fundamental input to rational choice under uncertainty.[11] The same processes take place at the macro level of state authorities making climate adaptation policies and regulations. Authorities are faced with the huge challenge of regulating for an uncertain future and with dealing with "low probability, high consequence events". It requires a proactive and long term approach of policy makers and regulators; an approach in which they can rely less on front-end methodologies,[12] such as environmental impact assessments, regulatory impact assessments, and cost benefit analyses.[13] Laws and regulations have to leave room for long term decision-making under uncertainty and give the decision-makers the tools to still reach legitimate decisions.

[10] Paul Kleindorfer, "Interdependency of Science and Risk Finance in Catastrophe Insurance and Climate Change", 18 January 2010, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1538161 (last accessed on 25 February 2012), at 10.

[11] Ibid., at 12–13.

[12] J.B. Ruhl, "Climate Change Adaptation and the Structural Transformation of Environmental Law", 40 *Environmental Law* (2010), 363.

[13] Climate change decision-making truly shook up discussions on cost benefit analyses because it forces us to think about how to value the benefits for future generations in today's currency. See extensively Richard L. Revesz and Matthew R. Shahabian, "Climate Change and Future Generations", 15 August 2010, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1666423 (last accessed on 25 February 2012).

11.2.4 Climate Ethics

Like the whole international climate change debate, discussions on adaptation have a strong ethical dimension too. Many claim that developed states, by not taking the lead in an aggressive mitigation scheme, place the burden of climate change, almost entirely caused in developed countries, on the shoulders of people living in poor countries and people belonging to the next generation. This process is labeled "an ethical failure."[14] Developed countries and future generations are facing huge adaptation challenges which they either cannot afford, or which are technically unfeasible. In 2007, the UNFCCC estimated the total global adaptation costs in 2030 to amount to $49–171 billion per annum, of which $27–66 billion would accrue in developing countries.[15] A 2009 evaluation of these calculations showed that the actual costs may very well be a factor 2 or 3 higher.[16] As discussed below, therefore, current international negotiations mainly focus on generating funds for developing countries to meet these costs. Nevertheless, there exists also a strong body of literature arguing that climate law and policy should focus on the environmental problem of climate change instead of connecting climate change policies to developmental policies.[17] It may not come as a surprise that this approach is criticized in an equally strong body of literature.[18]

11.3 Adaptation in the International Climate Regime

11.3.1 Introduction

It is fair to say that adaptation law originates at the international level. Both the 1992 United Nations Framework Convention on Climate Change,[19] and the 1997 Kyoto Protocol[20] comprise various obligations for the parties to these international

[14] Stephen M. Gardiner, *A Perfect Moral Storm: The Ethical Tragedy of Climate Change* (Oxford: Oxford University Press, 2011).

[15] UNFCCC, Investment and Financial Flows to Address Climate Change (Bonn: UNFCCC, 2007).

[16] Martin Parry et al., "Assessing the Costs of Adaptation to Climate Change. A Review of the UNFCCC and other Recent Estimates", 2009, available at: http://pubs.iied.org/pdfs/11501IIED.pdf (last accessed on 25 February 2012).

[17] For example, Eric A. Posner and David Weisbach, *Climate Change Justice* (Princeton, NJ: Princeton University Press, 2010).

[18] For example: Rosemary Lyster, "Towards a Global Justice Vision for Climate Law in a Time of 'Unreason'", June 2011, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1943818 (last accessed on 25 February 2012).

[19] United Nations Framework Convention on Climate Change (UNFCCC), New York, 9 May 1992, in force 21 March 1994, 31 I*nternational Legal Materials* (1992), 849.

[20] Kyoto Protocol to the United Nations Framework on Climate Change, Kyoto, 10 December 1997, in force 16 February 2005, 37 *International Legal Materials* (1998), 22.

agreements to adopt and implement adaptation policies. The documents also impose upon developed countries the duty to, both financially and practically, assist developing countries with their adaptation actions. In the international arena, most attention is going to the latter issue, as will be obvious from the overview of the most important adaptation related actions both under the UNFCCC (Sect. 11.3.2) and under the Kyoto Protocol (Sect. 11.3.3).

11.3.2 International Adaptation Law Under the UNFCCC

11.3.2.1 Adaptation in the UNFCCC

The primary objective of the UNFCCC, as laid down in Article 2, is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. Mitigation, according to the objective of the UNFCCC, is supposed to be successful so that ecosystems, food production and the economy are more or less automatically kept as they were before.

Fifteen years later, the IPCC sounded the alarm bell. Adaptation is necessary to address impacts resulting from the warming which is already unavoidable due to past emissions. For impacts that already show or will show in the very near future, adaptation is *the only available and appropriate response*, according to the IPCC in 2007.[21]

Fortunately, we did not have to start from scratch after these alarming words of the IPCC had been published. As a matter of fact, other than the objective of the UNFCCC cited above suggests, the 1992 convention focuses not just on combating climate change, but also on combating the adverse effects of climate change. This is obvious from the principles of the UNFCCC, laid down in Article 3. Developed country Parties, for instance, should take the lead in combating the adverse effects of climate change.[22] Developing country Parties that are particularly vulnerable to the adverse effects of climate change should be given full consideration.[23] Precautionary measures should be taken to mitigate the adverse effects of climate change.[24]

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[21] Adger et al., "Summary for Policymakers", supra, note 1, at 18.

[22] UNFCCC, supra, note 20, Art. 3(1).

[23] Ibid., Art. 3(2).

[24] Ibid., Art. 3(3).

Under the commitments listed in Article 4 of the UNFCCC there are several commitments that deal with adaptation. Parties to the Convention have to:

- formulate, implement, publish and regularly update national and regional programmes containing measures to facilitate adequate adaptation to climate change[25];
- cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods[26];
- take climate change considerations into account in the relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures taken by them to adapt to climate change[27];
- promote and cooperate in research (scientific, technological, technical, socio-economic and other) intended to further the understanding and to reduce the remaining uncertainties regarding the economic and social consequences of various response strategies,[28] as well as exchange information on this[29]; and
- promote and cooperate in education, training and public awareness related to climate change in general, thus including adaptation issues.[30]

In addition to this impressive list of adaptation duties, even further obligations have been imposed on developed country parties. They also have to help developing countries with their adaptation policies by:

- assisting developing countries that are particularly vulnerable to the adverse effects of climate change in meeting the costs of adaptation to those adverse effects[31]; and by
- taking all practicable steps to promote, facilitate and finance the transfer of, or access to, environmentally sound technologies and know how to developing country Parties, to enable them to implement the provisions of the UNFCCC[32]; this obligation, thus, also relates to the adaptation provisions mentioned above. Hence, the transfer of technology not only applies to mitigation technologies, but also to technologies and know-how necessary to implement adaptation measures.

[25] Ibid., Art. 4(1)(b).
[26] Ibid., Art. 4(1)(e).
[27] Ibid., Art. 4(1)(f).
[28] Ibid., Art. 4(1)(g).
[29] Ibid., Art. 4(1)(h).
[30] Ibid., Art. 4(1)(i).
[31] Ibid., Art. 4(4).
[32] Ibid., Art. 4(5).

An especially interesting provision on adaptation commitments is Article 4(8), in which all Parties are compelled to focus on the specific needs and concerns of developing country Parties arising from the adverse effects of climate change and the impact of the implementation of response measures. A whole range of countries especially vulnerable to the effects of climate change is mentioned here: small island countries, countries with low-lying coastal areas, countries with arid and semi-arid areas, forested areas and areas liable to forest decay, countries with areas prone to natural disasters, countries with areas liable to drought and desertification, countries with areas of high urban atmospheric pollution, countries with areas with fragile ecosystems, including mountainous ecosystems, countries whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products, and landlocked and transit countries.

All subsequent provisions of the UNFCCC, on such issues as research and systematic observation, education, training and public awareness, the financial mechanism, etc., apply to both mitigation and adaptation.[33] The two subsidiary bodies that are established by the UNFCCC,[34] the Subsidiary Body for Scientific and Technological Advice (SBSTA), and the Subsidiary Body for Implementation (SBI), both are competent to deal with adaptation issues.

11.3.2.2 National Adaptation Programmes of Action

Many countries have developed national adaptation programmes pursuant to Article 4(1)(b) of the UNFCCC. Developing countries, however, appeared to be largely unable to draft such programmes. Since such a programme is considered to be the first step towards financing and implementation of adaptation measures, the conference of the parties, in its 2001 session in Marrakesh, adopted guidelines for the preparation of National Programmes of Action (NAPAs)[35] to assist the least developed countries in the process,[36] and established a Least Developed Country Fund (LDCF).[37] This has been quite successful. By 2011, 45 least developed countries had submitted their NAPAs, containing detailed priority policies to respond to their urgent and immediate needs to adapt to climate change.[38] Each NAPA reports on the urgent

[33] Ibid., Arts. 5 and seq.

[34] Ibid., Arts. 9 and 10.

[35] Not to be confused with NAMAs, Nationally Appropriate Mitigation Actions.

[36] Decision 28/CP.7, Guidelines for the preparation of national adaptation programmes of action, FCCC/CP/2001/13/Add.4, 21 January 2002.

[37] Decision 7/CP.7, Funding under the Convention, UN Doc. FCCC/CP/2011/13 Add.1, 15 March 2012.

[38] The secretariat of the UNFCCC makes all of these available through their website, available at: http://unfccc.int/cooperation_support/least_developed_countries_portal/submitted_napas/items/4585.php (last accessed on 25 February 2012).

and immediate needs for which further delay could increase vulnerability to climate change or lead to increased costs at a later stage.

The 2010 Nepal NAPA, for instance, formulates extensive policies to increase communities' resilience in the field of water management, agriculture, disaster management, forest and ecosystem management, public health, and others.[39] Associated with these policies is an impressive list of over a hundred specific climate adaptation options for agriculture and food security, for the water sector, for the energy sector, for forests and biodiversity, for public health, for urban settlements and infrastructure, and to address climate-induced disasters. Concrete measures range from simple practical measures such as tree planting around farm lands and water resources in mountainous regions[40] and better rain water collection,[41] to complex legal measures such as a zoning program to adapt to water induced disasters and the associated activation of an inundation committee,[42] and the enforcement of planning regulations and building codes in urban areas incorporating climate change dimensions.[43]

After submission to the secretariat, the NAPA enters the so called GEF cycle which allows for funding of the projects identified in the NAPA under the LDCF, which is administered by the Global Environment Facility (GEF). The GEF is a financial organization instituted by governments, international organizations such as the World Bank and UNEP, NGOs and the private sector, to fund environmental projects in developing countries.[44]

11.3.2.3 The Buenos Aires Programme of Work on Adaptation and Response Measures and the Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change

Since the adoption of the UNFCCC in 1992, adaptation has been an issue during several Conferences of the Parties (COP), particularly those held in Buenos Aires in 2004, and in Cancun in 2010. COP10 in Buenos Aires led to the adoption of the Buenos Aires Programme of Work on Adaptation and Response Measures, which is a rather weak attempt to push adaptation, especially in developing countries, forward. Developing countries were requested to make use of the NAPA opportunities mentioned above, developed countries were asked to make available additional funding for adaptation measures under NAPAs, and the GEF was requested to step

[39] Government of Nepal, "National Adaptation Programme of Action (NAPA) to Climate Change", 2010, available at: http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=7329#beg (last accessed on 25 February 2012).

[40] Ibid., at 69.

[41] Ibid., at 68.

[42] Ibid., at 70.

[43] Ibid., at 77.

[44] For more information, see the GEF's website, available at: http://www.thegef.org (last accessed on 25 February 2012).

up its activities in the implementation phase of the NAPAs. In addition to this, the Buenos Aires programme of work initiated additional information gathering and capacity-building measures. Finally, the SBSTA was requested to develop a 5-year programme of work on scientific, technical and socio-economic aspects of impacts, vulnerability and adaptation to climate change.[45]

This 5-year programme was adopted 1 year later during COP11 in Montreal,[46] and has as its main objective to assist the parties, especially developing countries, to improve their understanding of impacts, vulnerability and adaptation, and to make informed decisions on practical adaptation actions. The SBSTA operationalized this again 1 year later during COP12 in Nairobi,[47] hence its current name: Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change (NWP) "Understanding Vulnerability, Fostering Adaptation". This programme has been running ever since and acts as a coordination mechanism for a wide variety of capacity-building and information dissemination activities by some 200 organizations, including private companies such as insurance firms and consultancy firms, universities and other research institutes, development banks and other financial organizations, NGOs, and charity organizations.[48]

11.3.2.4 The Cancun Adaptation Framework and the Adaptation Committee

It was only in 2010 that the COP placed adaptation high on its agenda. In the Cancun Agreements, adopted in 2010, the conference dealt with adaptation first (before mitigation), stating that enhanced action on adaptation was urgently needed.[49] The conference decided to establish the Cancun Adaptation Framework under which all parties to the UNFCCC will[50]:

- Plan, prioritize and implement adaptation actions;
- Assess adaptation actions, including economic, social and environmental evaluation of adaptation options;

[45] Decision 1/CP.10, Buenos Aires Programme of Work on Adaptation and Response Measures, FCCC/CP/2004/10/Add. 1., 19 April 2005.

[46] Decision 2/CP.11, Five-year Programme of Work of the Subsidiary Body for Scientific and Technological Advice on Impacts, Vulnerability and Adaptation to Climate Change, UN Doc. FCCC/CP/2005/5/Add. 1, 30 March 2006.

[47] Report of the Subsidiary Body for Scientific and Technological Advice on its Twenty-Fifth Session, UN doc. FCCC/SBSTA/2006/11, 1 February 2007, at 5–13.

[48] Information on activities and organizations involved can be found at the UNFCCC's website, available at: http://unfccc.int/adaptation/nairobi_work_programme/items/3633.php (last accessed on 25 February 2012).

[49] Decision 1/CP.16, The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention, UN Doc. FCCC/CP/2010/7/Add. 1., 15 March 2011.

[50] Ibid.

- Strengthen institutional capacities for adaptation;
- Build resilience of socio-economic and ecological systems;
- Enhance climate change related disaster risk reduction strategies, taking into consideration early warning systems, risk assessment and management, and sharing and transfer mechanisms such as insurance;
- Take measures to enhance understanding, coordination and cooperation with regard to climate change induced displacement, migration and planned relocation;
- Research, develop and diffuse technologies, practices and processes for adaptation;
- Strengthen information, education and public awareness;
- Improve climate related research in order to help provide information to decision-makers at the national and regional levels.

The Adaptation Committee (AC) was established to promote the implementation of all this.[51]

11.3.3 International Adaptation Law Under the Kyoto Protocol

11.3.3.1 Adaptation in the Kyoto Protocol

Five years after the adoption of the UNFCCC, the Kyoto Protocol mainly focused on the reduction of greenhouse gas emissions and not on adaptation. Given the stage of international discussions on climate change at that time, this was to be expected: a substantial first step towards greenhouse gas emission reductions was within reach. This explains why the Kyoto Protocol's provisions on adaptation are a bit meager.

The Protocol does work out a little further the general provisions of the UNFCCC mentioned above. It states that the programmes to facilitate adequate adaptation to climate change have to concern the energy, transport and industry sectors as well as agriculture, forestry and waste management, and that adaptation technologies as well as spatial planning are important elements in such adaptation policies.[52] In addition, the Kyoto Protocol regulates that information on such national adaptation policies has to be integrated into the communication that has to be submitted to the secretariat of the UNFCCC.[53] From a practical point of view, the most important provision on adaptation in the Kyoto Protocol probably is a section in the provision on the Clean Development Mechanism, stating that money generated through CDM projects should be used to assist developing countries to meet the

[51] Ibid. During the Durban COP in 2011, composition of, and modalities and procedures for, the Adaptation Committee were adopted. It yet has to develop its work plan.

[52] Kyoto Protocol, supra, note 21, Art. 10(b)(i).

[53] Ibid., Art. 10(b)(ii).

costs of adaptation.[54] It was this provision that, 4 years later, formed the basis for the establishment of the Adaptation Fund.

11.3.3.2 Adaptation Fund and Other Funds

The Adaptation Fund was established during COP7 of the UNFCCC in Marrakesh in 2001,[55] but it operates under the Kyoto Protocol. Its aim is to finance concrete adaptation projects in developing country parties to the Kyoto Protocol, as well as some specific adaptation activities that are not limited to developing countries. The latter is a consequence of another decision taken in Marrakesh which aimed at the following activities [56]:

- Starting to implement adaptation activities promptly where sufficient information is available to warrant such activities, in the areas of water resource management, land management, agriculture, health, infrastructure development, fragile ecosystems, including mountainous ecosystems, and integrated coastal zone management;
- Improving the monitoring of diseases and vectors affected by climate change, and related forecasting, and improving disease control and prevention;
- Supporting capacity-building for preventive measures, planning, preparedness and management of disasters relating to climate change, including contingency planning, in particular, for droughts and floods in areas prone to extreme weather events;
- Strengthening and, if necessary, establishing national and regional information networks for rapid response to extreme weather events.

It was not until the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (COP/MOP) first convened in 2005 in Montreal that the Adaptation Fund materialized.[57] In the next few years, various decisions were taken to operationalize the Fund, first, in 2006, by adopting its guiding principles,[58] then, in 2007, more importantly, by instituting the Adaptation Fund Board (AFB) as the operating entity of the Fund.[59] Although the COP/MOP remains in control over the Adaptation Fund, the AFB does have considerable power over the actual

[54] Ibid., Art. 12(8).

[55] Decision 10/CP.7, Funding under the Kyoto Protocol, UN Doc. FCCC/CP/2001/13/Add.1, 21 January 2002.

[56] Decision 5/CP.7, Implementation of Article 4, paragraphs 8 and 9, of the Convention (decision 3/CP.3 and Article 2, paragraph 3, and Article 3, paragraph 14, of the Kyoto Protocol), UN Doc. FCCC/CP/2001/13/Add.1, 21 January 2002.

[57] Decision 28/CMP.1, Initial guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the Adaptation Fund, UN Doc. FCCC/KP/CMP/2005/8/Add.4, 30 March 2006.

[58] Decision 5/CMP. 2, Adaptation Fund, UN Doc. FCCC/KP/CMP/2006/10/Add.1, 2 March 2007.

[59] Decision 1/CMP. 3, Adaptation Fund, UN Doc. FCCC/KP/CMP/2007/9/Add.1, 14 March 2008. On the functioning of the Adaptation Fund, see in more detail Ralph Czarnecki and Kaveh Guilanpour, "The Adaptation Fund after Poznań", 3 *Carbon and Climate Law Review* (2009), 79.

funding process.[60] The AFB is a legal entity under German law,[61] with involvement of both the GEF and the World Bank, acting as secretariat and trustee respectively.[62] The Adaptation Fund is financed by a fixed share of 2% of the proceeds of all CDM project activities (2% of the Certified Emission Reductions, or CERs, issued for a CDM project to be precise), as well as individual donations by countries.

Finally, in 2010, almost 10 years after the decision was taken to establish an adaptation fund, the AFB took its first decision to fund an adaptation project, namely an adaptation project to coastal erosion due to sea level rise in Senegal.[63]

Besides the Adaptation Fund, there are two more funds, both of which operate under the UNFCCC. Like the Adaptation Fund, the Special Climate Change Fund (SCCF) and the LDCF were established during COP7 in Marrakesh in 2001.[64] The SCCF is a general fund, aimed at financing activities, programmes and measures relating to climate change in a number of areas, one of which is adaptation (the others being transfer of technology, energy, transport, industry, agriculture, forestry, waste management, and activities that assist developing countries to diversify their economies). The LDCF, as it name already indicates, is specifically aimed at financing projects in the least developed countries, particularly, as indicated above in Sect. 11.3.2.2, those related to their NAPAs. Both funds are operated by the GEF, and their councils have joint meetings. They both mainly rely on voluntary contributions from Annex I states.

Examples of projects funded under the joined funds are for instance a project to promote the implementation of national and transboundary integrated water resource management that is sustainable and equitable given expected climate change in Swaziland, a project integrating climate change risks into water and flood management by vulnerable mountainous communities in the Greater-Caucus region of Azerbaijan, and a project to promote a value chain approach to adaptation in agriculture in Ghana.[65]

With the proliferation of funds, there is a clear risk of overlap and of inefficiency. The GEF, involved in all of them, as well as in their own GEF Trust Fund, which initially also had funding of adaptation measures as one of its main goals,[66] is aware of that. In their 2010 Revised Programming Strategy on Adaptation to Climate Change, the GEF Council tries to show how the different adaptation related funds

[60] Its rules of procedure were adopted in 2008, Decision 1/CMP.4, Adaptation Fund, UN Doc. FCCC/KP/CMP/2008/11/Add.2., 19 March 2009.

[61] Decision 5/CMP. 6, Report of the Adaptation Fund Board, UN Doc. FCCC/KP/CMP/2010/12/Add.1, 15 March 2011.

[62] MOU's with both institutions have been concluded to formalize this involvement. Decision 1/CMP. 4, UN Doc. FCCC/KP/CMP/2008/11/Add.2, supra, note 62, paras. 11 and 12.

[63] Information on the projects funded under the Adaptation Fund is available from the AFB's website, available at: http://www.adaptation-fund.org (last accessed on 25 February 2012).

[64] Decision 7/CP.7, Funding under the Convention, UN Doc. FCCC/CP/2001/13/Add.1, 21 January 2002.

[65] UN Doc. GEF/LDCF/SCCF.9/JointSummary, 18 November 2010.

[66] Through its Strategic Priority on Adaptation, a 50 million USD allocation inside of the GEF Trust Fund. As of 2010, the SPA was merged with the SCCF/LDCF, see the GEF website, available at: http://www.thegef.org/gef/adaptation (last accessed on 25 February 2012).

are all complimentary.[67] The arguments used are not particularly strong though. The fact that the LDCF and the SCCF have a mandate under the UNFCCC and the Adaptation Fund under the Kyoto Protocol, for instance, is but a formal argument. The fact that their revenues come from different sources is not a strong argument either, nor is the argument that the LDCF and the SCCF, other than the Adaptation Fund, are aimed at other issues than adaptation as well.

The biggest problem of the funds, however, is the lack of available funds. In the 42 NAPAs that had been submitted by 2009, urgent adaptation measures have been laid down of a total cost of around 2 billion USD.[68] In 2010, however, the LDCF received a total of pledges of 131.5 million USD, and the SCCF a total of 49.8 million USD from Annex I states. The largest contributors for both funds in 2010 were the United States and Germany, both with donations of around 50 million USD in total (for both funds together). Current funding is totally inadequate to address just the most urgent and immediate adaptation needs of the least developed countries. It is, therefore, not surprising that the least developed countries raise this issue in every COP, and not without success. At the Copenhagen and Cancun meetings in 2009 and 2010, pledges were made by developed countries to provide new and additional resources approaching USD 30 billion for the period 2010–2012, with a balanced allocation between adaptation and mitigation, and with prioritizing funding for adaptation for the most vulnerable developing countries, such as the least developed countries, small island developing states and Africa.[69] In addition to that, the developed countries even committed to the goal of mobilizing jointly 100 billion USD per year by 2020 to address the needs of developing countries.[70] These funds should be channeled through again a new fund, the Green Climate Fund (GCF), established in Cancun in 2010.[71] The set up of this new fund, however, saw a slow start with the first meeting of the Transitional Committee, entrusted with the task to draft the operating documents of the GCF, postponed to late April 2011 because of lack of agreement of the composition of this committee. Although this had been resolved by the Durban COP in 2011, the GCF still has to be further operationalized.

11.4 Adaptation in the Various Policy Fields

As already stated above (Sect. 11.2), adaptation touches upon almost everything. It should therefore not come as a surprise that many fields of law are to be addressed. In this section, laws related to the most important policy fields affected by the impact

[67] Revised Programming Strategy on Adaptation to Climate Change for the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF), UN Doc. GEF/LDCF.SCCF.9/4/Rev.1, 19 October 2010, at 7–9.

[68] See the LDC Expert Group, The Least Developed Countries. Support Needed to Fully Implement National Adaptation Programmes of Action (NAPAs) (Bonn: UNFCCC, 2009), at 17.

[69] FCCC/CP/2010/7/Add.1, supra, note 50, at 16.

[70] Ibid., at 17.

[71] Ibid.

of climate change, will be briefly reviewed. The main purpose of this section is to give an idea of the kind of legal arrangements that have to be in place in order to facilitate adaptation measures. Within the context of this chapter, it is not possible to extensively deal with all legal issues involved in all of these policy fields.[72] We focus our attention on marine and coastal adaptation (Sect. 11.4.1), water management adaptation (Sect. 11.4.2), adaptation in planning and land use law, buildings and infrastructure (Sect. 11.4.3), adaptation and energy and telecommunications (Sect. 11.4.4), adaptation and migration (Sect. 11.4.5), adaptation and biodiversity (Sect. 11.4.6). Section 11.4.7 briefly mentions other relevant fields of laws.

11.4.1 Marine and Coastal Adaptation

Sea level rise, disappearing islands, melting ice in the arctic and Antarctic, increased storm intensity, shifting ranges of fish stocks and ocean acidification have a profound impact on marine and coastal law, especially in such fields as maritime jurisdictional claims, fisheries, marine biodiversity, and coastal defences. Let us briefly look into these fields.

Sea level rise leads to receding low-water baselines. As a consequence, maritime zones will also retreat, leading to a potential loss of maritime jurisdiction of coastal states. This would then have strong economic consequences, as the right over natural resources is threatened. This is even more so in cases where islands determine maritime jurisdiction. Once islands start to disappear altogether, huge jurisdictional changes will be apparent. It has been suggested that there may be a need for a new process or understanding regarding either the fixing of normal baselines and/or maritime limits. This might develop through State practice, with coastal States choosing particular charts for maritime jurisdictional purposes or simply declaring the location of the limits of their maritime claims. Multilateral negotiations probably are inevitable.[73] The consequences of the disappearance of small island states, obviously, are huge. Responses to such a loss of statehood that have been suggested are the acquisition of "new" territory, merger or confederation with a non-inundation threatened State, and the creation of a new legal category of "deterritorialised" State.[74]

The transformation of the Arctic Ocean from an ice-covered sea to a seasonally ice-free sea, has many legal consequences, especially in the field of international law. States in this region are adapting to the new situation by extending their jurisdiction on the basis of Art. 76 of the UN Convention on the Law of the Sea (UNCLOS), thus aiming to get control of natural resources in the area (especially

[72] For such an extensive overview, see: Jonathan Verschuuren (ed.), *Research Handbook on Climate Adaptation Law* (Cheltenham: Edward Elgar Publishers, 2012).

[73] Clive Schofield, "Shifting Limits? Sea Level Rise and Options to Secure Maritime Jurisdictional Claims", 3 *Carbon and Climate Law Review* (2009), 405.

[74] Ibid., at 415.

fossil fuels) and of water ways.[75] A military build-up is emerging, and non-arctic nations are getting involved as well. It is expected that the Arctic Council, consisting of eight Arctic nations with the involvement of indigenous peoples organizations, will have to lead this process. The Arctic Council, however, has no regulatory authority. Some existing international law can be used as well, especially rules administered by the International Maritime Organization,[76] the North-East Atlantic Fisheries Commission (established under Art. 118 UNCLOS), and rules under the 1992 Convention for the Protection of the North-East Atlantic (OSPAR). In due course, however, it is expected that the adoption of a new arctic (polar) treaty, perhaps along the lines of the Antarctic Treaty, is inevitable.[77]

Ocean warming and increases in the amount of CO_2 dissolved in the ocean leads to a loss of habitat forming species (e.g. corals, giant kelp, sea grasses and mangroves), declines in ocean productivity and shifts in the geographic distributions and latitudinal ranges of marine organisms. This has a profound impact on fisheries and on people depending on fish for food or livelihood.[78] Habitat restoration and the large-scale designation of marine protected areas are necessary to help marine biodiversity adapt to their changing environment. In the EU, the Marine Strategy Framework Directive and the Birds and Habitats Directives offer a legal framework for these measures. On the basis of these instruments, areas will have to be closed for fishing to help stocks to recover. Fisheries laws, such as those designed to implement the Common Fisheries Policy in the EU, will have to be used to regulate the redistribution of fisheries rights. Scientists have shown that we can expect a large-scale redistribution of global catch potential, with an average of 30–70% increase in high-latitude regions and a drop of up to 40% in the tropics.[79]

Coastal defence systems are under pressure because of sea level rise and increased storm intensity. With ineffective defence systems in place, coastal erosion and inundation of low lying areas is to be expected. Low lying coastal cities are especially vulnerable and receive a lot of attention in the academic and public debate. Within the context of various international legal instruments, there is growing attention for taking adaptation measures in coastal areas. In a 2009 Report, the OSPAR Commission reviewed the national adaptation policies of its member states and urged states to integrate adaptation measures into Integrated Coastal Zone Management (ICZM)

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[75] Paul Arthur Berkman and Oran R. Young, "Governance and Environmental Change in the Arctic Ocean", 324 *Science* (2009), at 339.

[76] Already in 2002, the IMO established the "Guidelines for ships operating in ice-covered arctic waters".

[77] Berkman and Young, "Governance and Environmental change in the Arctic Ocean", supra, note 76, at 340.

[78] John D. Koehn et al., "Climate Change and Australian Marine and Freshwater Environments, Fishes and Fisheries: Synthesis and Options for Adaptation", 62 *Marine and Freshwater Research* (2011), 1148; Alexander Proelss and Monika Krivickaite, "Marine Biodiversity and Climate Change", 3 *Carbon and Climate Law Review* (2009), 437.

[79] William W. L. Cheung et al., "Large-scale Redistribution of Maximum Fisheries Catch Potential in the Global Ocean under Climate Change", 16 *Global Change Biology* (2010), 24.

and marine spatial planning, as facilitated by both the OSPAR Convention and the EU's Marine Strategy Framework Directive and the Water Framework Directive.[80] In addition, coastal adaptation is one of the key issues integrated in the North-East Atlantic Environmental Strategy, adopted at the 2010 OSPAR ministerial conference.[81] Also in 2010, the UN General Assembly encouraged states to develop means of marine and coastal adaptation under the UNCLOS and other relevant international frameworks.[82] The UNCLOS secretariat itself produced a general document on oceans and climate change, in which some attention is paid to adaptation by stating that the resilience of coastal ecosystems such as mangroves, salt marshes and sea grasses should be enhanced, that integrated conservation and managements measures to protect marine species should be adopted and that the vulnerability of coastal communities, particularly in developing countries, should be reduced by capacity building and transfer of technology.[83]

The EU has adopted binding legislation forcing its member states to develop coastal and estuarine adaptation law. These requirements stem from the 2000 Water Framework Directive (WFD),[84] the 2007 Floods Directive,[85] the 2008 Marine Strategy Framework Directive (MSFD),[86] as well as a series of non-legally binding policy documents in which member states are urged to incorporate adaptation in their coastal management.[87] EU member states like the UK and the Netherlands have already prepared new legislation that enables the authorities to take far-reaching adaptation measures in coastal areas.[88] A recent comparative study showed that an integrated approach to coastal adaptation law is currently needed to lay the foundations for the required long-term strategy.[89] Such an approach would establish processes by which adaptation objectives are agreed for each part of the coast; ensure land use

[80] OSPAR Commission, "Assessment of Climate Change Mitigation and Adaptation", 2009, available at: http://www.ospar.org (last accessed on 15 February 2012), at 22–28.

[81] The North-East Atlantic Environment Strategy, Strategy of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic 2010–2020 (OSPAR Agreement 2010–2013), Annex 25, available at: http://www.ospar.org (last accessed on 15 February 2012).

[82] Resolution 64/71 (114), UN Doc. A/RES/64/71, 12 March 2010.

[83] Oceans and Climate Change, "Division for Ocean Affairs and the Law of the Sea of the UN", 2010, available at: http://www.un.org/Depts/los/oceans_climate_change/oceans_climate_change_7_september_2010.pdf (last accessed on 15 February 2012).

[84] Directive 2000/60/EC establishing a Framework for Community Action in the Field of Water Policy, OJ 2000 L 327.

[85] Directive 2007/60/EC on the Assessment and Management of Flood Risks, OJ 2007 L 288.

[86] Directive 2008/56/EC establishing a Framework for Community Action in the Field of Marine Environmental Policy, OJ 2008 L 164.

[87] Such as the 2002 Recommendation 2002/413/EC concerning the implementation of Integrated Coastal Zone Management in Europe, OJ 2002 L 148, and the 2009 White Paper, Adapting to Climate Change: Towards a European Framework for Action, COM(2009)0147 final.

[88] Jonathan Verschuuren and Jan McDonald, "Towards a Legal Framework for Coastal Adaptation: Assessing the First Steps in Europe and Australia", 1 *Transnational Environmental Law* (forthcoming 2012).

[89] Ibid.

planning that can accommodate future change and does not expose new communities to risk; integrate coastal adaptation with biodiversity and coastal zone policy; allocate regulatory responsibility in a way that promotes subsidiarity and consistency; and ensures that funds are available for future measures.

11.4.2 Water Management Adaptation

The impact of climate change on river basins has already been apparent for a number of years. Already in 2007, the UNECE finds that "most basins experience an impact of climate change on water quantity (e.g. decreasing water resources availability and extreme hydrological events, including severe floods and long-lasting droughts). With a reduction in precipitation of up to 30% over the last decade, water resources availability, for example, is decreasing in river basins in the discharge area of the Mediterranean Sea. The effects of climate change on the ecological regime of rivers are also becoming visible in transboundary basins in Central Asia, where the rise in air temperatures leads to significant melting of glaciers, resulting in noteworthy changes of the river's hydrological and ecological regimes. Thus, climate change adaptation measures in water management and water-depended activities and services (e.g. agriculture, forestry, water supply, hydropower generation) are needed in the entire UNECE region."[90] The same region saw an increase in the average number of annual disastrous weather and climate-related events by about 65% between 1998 and 2007,[91] many of which impacted water and wastewater services systems.

In the area of water management, we have the relative advantage that, almost universally, an integrated river basin approach is applied.[92] Such a holistic approach to all interrelated water issues is particularly relevant to water adaptation measures.[93]

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[90] UNECE, Our Waters: Joining Hands across Borders. First Assessment of Transboundary Rivers, Lakes and Groundwaters (New York and Geneva: UNECE, 2007), at 29.

[91] European Environment Agency, Impacts of Europe's Changing Climate, 2008 Indicator-based Assessment, EEA Report 04/2008, 2008, at 169.

[92] Based upon the UNECE Convention on International Watercourses and Transboundary Lakes, Helsinki, 17 March 1992, 31 *International Legal Materials* (1992), 1312 and the UN Convention on the Law of the Non-navigational Uses of International Watercourses, New York, NY, 21 May 1997, 36 *International Legal Materials* (1997), 700.

[93] There is a wealth of academic papers in which this is acknowledged, see for instance: Craig A. Arnold, "Law's Adaptive Capacity and Climate Change's Impacts on Water", 5 *Environmental and Energy Law and Policy Journal* (2010), v. Craig A. Arnold, "Adaptive Watershed Planning and Climate Change", 5 *Environmental and Energy Law and Policy Journal* (2010), 417; Richard T. Kingsford, "Conservation Management of Rivers and Wetlands under Climate Change: A Synthesis", 62 *Marine and Freshwater Research* (2011), 217. Dan Tarlock, "Four Challenges for International Water Law", 23 *Tulane Environmental Law Journal* (2009), 369; David N. Cassuto and Romulo S. R. Sampaio, "Water Law in the United States and Brazil – Climate Change & Two Approaches to Emerging Water Poverty", 35 *William & Mary Environmental Law and Policy Review* (2011), 371; Poh-LingTan, "Adaptation Measures for Water Security in a Changing

Such measures may have to be aimed at preventing floods and minimising flood damage, as well as at mitigating the impact of droughts, even in one geographic area. In 2009, the COP to the UNECE Water Convention adopted the Guidance on Water and Adaptation to Climate Change,[94] prepared by the Task Force on Water and Climate.[95] These elaborate guidelines also take an integrated river basin approach as a starting point for adaptation measures. Integrated river basin planning, therefore, should plan for extreme events. Flood prevention and mitigation policies can make use of a wide range of instruments, such as the designation of water retention areas that are used for controlled flooding (thus releasing the pressure on other, for instance more densely populated areas), or the widening of the river bed (thus enhancing the capacity of the river to discharge larger amounts of water to the ocean), and/or the creation and management of controlled water levels through dams and other technical measures. In cities, storm water management is an important element of any water policy. Increased precipitation will put a greater pressure on storm water systems, which may lead to pollution in case the sewage system was not adapted to deal with an increased amount of storm water.[96]

Water scarcity and draughts have to be addressed in integrated river basin plans as well. Water scarcity occurs where there are insufficient water resources to satisfy long-term average requirements, whereas draughts are caused by a temporary decrease of the average water availability due to rainfall deficiency. Storing water on agricultural lands for later use, crop changes to less water intensive crops, or to crops that are resistant to salination, are examples of measures that can be integrated into river basin plans.[97]

Finally, it should be noted that mitigation measures may have a negative impact on water resources. Carbon dioxide capture and storage, for instance, may lead to groundwater degradation in case of leakages, while large scale hydro-electric power may have a negative impact on river ecosystems and fisheries. Hence the need to integrate mitigation and adaptation policies in the field of water management.

Climate: Policy, Planning and Law", in Tim Bonyhady, Andrew Macintosh and Jan McDonald (eds), *Adaptation to Climate Change. Law and Policy* (Sydney: The Federation Press, 2010), 135; Barbara Cosens and Mark Williams, "Resilience and Water Governance: Adaptive Governance in the Columbia River Basin", 2011, available at: SSRN: http://ssrn.com/abstract=1942587 (last accessed on 15 February 2012).

[94] Meeting of the Parties to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes Working Group on Integrated Water Resources Management, see UN Doc. UNECE/MP.WAT/29, 4–5 May 2011, at 10.

[95] Guidance on Water and Adaptation to Climate Change, ECE/MP.WAT/30, 15–16 December 2009.

[96] In 2010, the WHO and the UNECE issued Luciana Sinisi and Roger Aertgeerts, *Guidance on Water Supply and Sanitation in Extreme Weather Events* (Copenhagen: WHO/UNECE, 2010).

[97] See UNECE Convention on International Watercourses and Transboundary Lakes and UN Convention on the Law of the Non-navigational Uses of International Watercourses, supra, note 93.

11.4.3 Adaptation in Planning and Land Use Law, Buildings and Infrastructure

Land use law and spatial planning law are important instruments to adapt to a variety of climate change impacts. Most research in this field shows that adaptation and mitigation go hand in hand here.[98] As already mentioned above, land use law will have to be used to avoid unwanted development in areas prone to flooding, or even to remove existing buildings from such areas (in which case expropriation of property owners by be necessary as well). The same also goes for areas that need to be used for increased precipitation run off and stormwater management. These areas are not just at or below street level. Buildings may also be used for such purposes as reducing run off for instance through the use of green roofs (buildings partially or completely covered with vegetation and soil). Under the phrase of "green cities" or "green buildings", comprehensive plans are developed to design inner cities and its buildings in such a way that they both play a role in adaptation and mitigation. Next to applying land use law and zoning law, building requirements have to be set as well in building and/or construction codes.[99]

Planning and land use law are also important instruments for transport infrastructure adaptation. Both underground and surface transportation systems may be in areas prone to flooding and thus may have to be adapted. Elevated railwaylines are, for instance, are less vulnerable to flooding than non-elevated ones. Increased energy demand during heat waves may have a negative impact on trains and subways (see also Sect. 11.4.4 below). Material failure can be an issue during heat waves or during severe storms. Waterways can be affected both by droughts and by high water levels. All of these issues will have to be addressed in a transport infrastructure adaptation policy. Again, adaptation and mitigation are closely linked here. Smart neighbourhood planning so as to avoid urban sprawl and excessive transport needs and bicycle friendly land-use, are advocated as a means to both reduce the pressure on vulnerable transportation infrastructure and to mitigate GHG emissions by the transport sector at the same time.

As will be further discussed below, planning law is also vital to create connectivity between natural areas, thus helping biodiversity to adapt to the changing climate (see Sect. 11.4.6). Planning and building law may also play a role in policies

[98] See among others: Anne Leitch, Ben Harman and Marcus B. Lane, "From Blueprint to Footprint: Climate Change and the Challenge for Planning", in Tim Bonyhady, Andrew Macintosh and Jan McDonald (eds), *Adaptation to Climate Change. Law and Policy* (Sydney: The Federation Press, 2010), 63; John R. Nolon and Patricia. E. Salkin, "Integrating Sustainable Development Planning and Climate Change Management: A Challenge to Planners and Land Use Attorneys", 63 *Planning & Environmental Law* (2011), 3; Sussman et al., "Climate Change Adaptation: Fostering Progress Through Law and Regulation", supra, note 8, at 63–77.

[99] See extensively, Sussman et al., "Climate Change Adaptation: Fostering Progress Through Law and Regulation", supra, note 8, at 97–103 and Edna Sussman, "Reshaping Municipal and County Laws to Foster Green Building, Energy Efficiency, and Renewable Energy", 16 *N.Y.U. Environmental Law Journal* (2008), 1.

designed to reduce fire threats in areas prone to wild fires, for instance by regulating vegetation free zones around public buildings like schools, planning exit roads, setting building requirement aimed at making buildings better fire resistant.

11.4.4 Adaptation and Energy and Telecommunications

Energy demand is expected to sharply rise in those areas with increased heat waves during summer as the use of air conditioning will increase. Long periods of warm weather in summer may also lead to a shortage of cooling water for energy production. This may lead to energy fall out. That may also happen when floods or storms damage power infrastructure. Designing and planning for a robust power infrastructure, thus, is needed. Again, land use law, building law environmental permits for installations, but also water management law, will have to be applied to achieve that.[100] In literature, this goal usually is combined with the goal to reduce the use of energy as part of a mitigation strategy. Smart grids are often seen as the most important means to achieve both adaptation and mitigation targets in the energy sector.[101] The smart grid is an ICT-based transmission and distribution network, which provides for a better integration of renewable energy sources into the grid. Lyster shows that the Smart Grid gives utilities an enhanced ability to identify the location of a failure and quickly re-route electricity to locations where demand is most critical. "This could occur during times of climate change-induced crisis, or peak demand, and prevents outages through proactive diagnosis of the grid and its individual elements. Importantly, it enhances the ability of the grid to continue to provide power following a catastrophic event and to support vital emergency responses as well as military, economic and social activities during a crisis."[102] There are many legal aspects involved in the roll out of smart grids, not just in field of environmental, energy and competition law, but also concerning the protection of consumer privacy.

On a final note, it should be mentioned that for this sector, there are several opportunities as well, such as a higher potential for wind energy as well as for solar energy, whereas the overall demand in energy in a large parts of the world will decrease because of milder winters.

As far as telecommunications are concerned, similar adaptive measures will be necessary. Floods and severe winds may damage telecommunication infrastructure, whereas, at the same time, such events, simultaneously, may trigger a peak in telecommunications traffic. Telecommunications black outs can be caused by

[100] See among others, Dirk T. G. Rübbelke et al., "Impacts of Climate Change on European Critical Infrastructures: The Case of the Power Sector", 2010, available at: http://www.bc3research.org (last accessed on 15 February 2012).

[101] Zhen Zhang, "Smart Grid in America and Europe: Similar Desires, Different Approaches", 149 *Public Utilities Fortnightly* (2011).

[102] Rosemary Lyster, "Smart Grids: Opportunities for Climate Change Mitigation and Adaptation", 36 *Monash University Law Review* (2010), 173.

this, severely hampering disaster relief operations. Hence, regulating for network reliability is required.[103]

11.4.5 Adaptation and Migration

A lot of attention is focused on climate induced migration. Severe climatic events such as floods, as well as a gradual loss of fresh water availability or agricultural resources, can trigger human migration. Research shows that migration usually is caused by a multitude of factors, climate change being one of those. Such migration may be internal migration or cross border displacement. The increased pressure caused by the immigrants on the host communities can lead to food and water shortages, housing problems, unemployment and ultimately to violence and armed conflict.[104] Most legal research, so far, has aimed at identifying the most suitable international law approaches to dealing with cross border migration. Current refugee law is not applicable to environmental refugees as they are not forced to move for political reasons or human rights violations, hence suggestions to either come up with a new stand-alone international law instrument, or with the adoption of a protocol on climate refugees within the UNFCCC framework.[105] Research aimed at the role of international law in the prevention of armed conflicts as a consequence of climate change still has to emerge.

11.4.6 Adaptation and Biodiversity

Biologists have been observing many changes to biodiversity caused by climate change for years. They advocate making protected areas climate proof by making sure that these areas are large enough and stable enough to adapt to the changed climate. Protected areas should be able to live through flooding in winter, wild fires in the summer, storm damage and should have enough variety in habitat types to host new species. This for many protected areas means enormously intensified protection measures are to be taken, for instance by enlarging sites or connecting existing sites into one much larger site.[106] To prepare for the ecological impacts of climate

[103] See Sussman et al., "Climate Change Adaptation: Fostering Progress Through Law and Regulation", supra, note 8, at 114–115.

[104] Idean Salehyan, "From Climate Change to Conflict? No Consensus Yet", 45 *Journal of Peace Research* (2008), 315.

[105] Bonnie Docherty and Tyler Giannini, "Confronting a Rising Tide: A Proposal for a Convention on Climate Refugees", 33 *Harvard Environmental Law Review* (2009), 349; Brendan Gogarty, "Climate-change Displacement: Current Legal Solutions to Future Global Problems", 21 *Journal of Law, Information and Science* (2011), 1.

[106] For an overview see Saja Erens, Jonathan Verschuuren and Kees Bastmeijer, "Adaptation to Climate Change to Save Biodiversity: Lessons Learned from African and European Experiences", in Benjamin Richardson et al. (eds), *Climate Law and Developing Countries: Legal and Policy Challenges for the World Community* (Cheltenham: Edward Elgar, 2009), 206.

change, a landscape approach is needed in which existing protected areas are enlarged and secured and ecological corridors between areas are protected and restored, thus establishing a real ecological network that is resilient to future change. "Connectivity" is the key word in many biodiversity adaptation policies.[107]

In Europe, most attention focuses on the Birds – and Habitats Directives.[108] While there is some criticism as to the soft legal nature of some of its provisions,[109] the Habitats Directive does, in Article 10, propose that member states, in their land-use planning and development policies, maintain and develop features of the landscape of major importance for wild fauna and flora, thus improving the ecological coherence of the EU Natura 2000 network. Article 10 in particular mentions features which, by virtue of their linear and continuous structure (such as rivers with their banks or the traditional systems for marking field boundaries) or their function as stepping stones (such as ponds or small woods), are essential for the migration, dispersal, and genetic exchange of wild species. Most authors conclude on the basis of the combined duties arising from a variety of provisions in both EU Directives and relevant international conventions, such as the CBD, the Convention on Migratory species and the Bern Convention on the Conservation of European Wildlife and Natural Habitats, that there already exists a legal obligation within the EU to establish corridors and other measures to help biodiversity adapt to climate change.[110] Recent case law by the European Court of Justice seems to point in the same direction.[111]

11.4.7 Other Areas of Law

Besides the above obvious fields of law that play a major role in climate change adaptation, there are more areas to cover. Pollution control legislation must be used to control additional or altered environmental effects of emissions. Higher temperatures, for example, lead to elevated concentrations of ground level ozone, which is harmful to human health as well as to the vegetation. Hazardous waste facilities can be

[107] The Work Programme on Protected Areas adopted at the 2004 COP of the Biodiversity Convention, for instance, sets as a target for 2015 the integration of all protected areas and protected area systems into the wider land – and seascape by applying the ecosystem approach and taking into account ecological connectivity and the concept of ecological network, COP 7 Decision VII/28, Protected Areas, UN Doc. UNEP/CBD/COP/DEC/VII/28, 13 April 2004, Arts. 8(a) to (e).

[108] Directive 2009/147/EU on the Conservation of Wild Birds, OJ 2010 L 20/7, and Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna, OJ 1992 L 206/7.

[109] Jonathan Verschuuren, "Climate Change: Rethinking Restoration in the European Union's Birds and Habitats Directives", 28 *Ecological Restoration* (2010), 431.

[110] Arie Trouwborst, "Conserving European Biodiversity in a Changing Climate: The Bern Convention, the European Union Birds and Habitats Directives and the Adaptation of Nature to Climate Change", 20 *Review of European Community and International Environmental Law* (2011), 62; An Cliquet et al., "Adaptation to Climate Change: Legal Challenges for Protected Areas", 5 *Utrecht Law Review* (2009), 158.

[111] Case C-404/09, European Commission v. Kingdom of Spain [2011] ECR I-0000.

damaged during extreme weather events and floods, which may lead to pollution of large areas outside the waste facility. The impact of the 2011 tsunami on the Fukushima nuclear power plant shows that nuclear contamination of large areas may occur in extreme weather events. Tightened environmental rules for such installations are required. The instrument of environmental impact assessment is a promising tool for assessing the possible consequences of climate change on an installation.[112]

Disaster prevention and mitigation, and disaster response are other important areas of law. Basically, the entire disaster management system has to be employed to prevent and mitigate disasters and to respond to disasters, for instance caused by extreme weather events, floods, wild fires etc.[113]

Public health is affected by climate change in a great number of ways, examples of which are increased hospitalizations and deaths caused by heat spells, increased respiratory problems caused by elevated ozone levels also during heat spells, increased numbers of victims of vector-borne infectious diseases, and casualties from severe weather events and floods (including mental problems caused by such events). Although most attention has been focussed on emergency preparedness-law has to be ready so that emergency services are able to deal with a sudden influx of additional patients-, attention is now shifting to handling the substantial, slowly emerging, intensification of more routine health threats that are expected to be seen as an impact of climate change, both domestically[114] and internationally.[115]

Last, but certainly not least, mention should be made of the huge adaptation efforts needed in agriculture. Changing weather patterns, increasing draughts in some areas, and too much water in others (or in the same area, but in different parts of the year) and new plant diseases and pests, require changes in agricultural practices such as the choice of crops and the use of pesticides. Agricultural law can facilitate farmers to implement such changes.[116] As with most of the topics addressed in this chapter, adaptation measures in this field are strongly connected to mitigation actions. Low carbon agriculture is increasingly gaining popularity as this variety of measures both help farmers adapt to the changing climate, while at the same time

[112] Caleb W. Christopher, "Success by a Thousand Cuts: The Use of Environmental Impact Assessment in Addressing Climate Change", 9 *Vermont Journal of Environmental Law* (2007–2008), 549.

[113] Among others, Tim Bonyhady, "The Law of Disasters", in Tim Bonyhady, Andrew Macintosh and Jan McDonald (eds), *Adaptation to Climate Change: Law and Policy* (Sydney: The Federation Press 2010), 265.

[114] See Lindsay F. Wiley, "Adaptation to the Health Consequences of Climate Change as a Potential Influence on Public Health Law and Policy: From Preparedness to Resilience", 15 *Widener Law Review* (2009–2010), 483.

[115] Lindsay F. Wiley, "Moving Global Health Law Upstream: A Critical Appraisal of Global Health Law as a Tool for Health Adaptation to Climate Change", 22 *Georgetown International Environmental Law Review* (2010), 439.

[116] Robert W. Adler, "Balancing Compassion and Risk in Climate Adaptation: U.S. Water, Drought and Agricultural law", 64 *Florida Law Review* (2012), 201; Richard Munang and Johnson N. Nkem, "Using Small-scale Adaptation Actions to Address the Food Crisis in the Horn of Africa: Going Beyond Food Aid and Cash Transfers", 3 *Sustainability* (2011), 1510.

they reduce GHG emissions, which, depending on mitigation laws applicable, may lead to financial benefits for them as well.

The forestry sector will be confronted with similar impacts, such as reduced growth rates, changes in wood quality and quantity, increased pests, increased competition by exotics and increased fires. Changes in forest management systems are in order, and again, law can play a role to facilitate these changes.[117] Again, adaptation and mitigation go hand-in-hand, which is particularly visible in mechanisms for educing emissions from deforestation and forest degradation (such as REDD+): vegetation promoted by REDD+ not only mitigates GHG emissions, but also reduces erosion, protects biodiversity, and may provide a range of ecosystem services to local communities. Much, however, depends on how the measures are designed, as evidence shows that REDD+ may also lead to negative impacts on adaptation, for instance for biodiversity.[118]

11.5 Conclusion

More and more attention is focused on adaptation. It is clear that huge efforts are needed on a variety of areas to help the world adapt to the changing climate. In this chapter, the international law with regard to adaptation has been described and assessed, as well as domestic legal issues involved. It is obvious that a wide variety of measures needs to be taken using legal instruments from water law, marine law, planning and land use law, building law, biodiversity law, agriculture law, etc. etc. In fact, almost all the laws that we use to facilitate basic economic and societal processes may have to play a role in the transformational changes that we have to start. In some fields, such as coastal adaptation and biodiversity, such transformations have already started, at least in some countries. In general, however, it must be concluded that adaptation law is still in its infancy. Sometimes existing laws can be used to foster adaptation, more often, laws will first have to be adapted themselves before they provide the right instruments to foster adaptation. Internationally, much attention is focused on developing countries. Financial instruments are currently being developed at the international level to assist these countries with their adaptation efforts. Legal assistance will be required as well, given the enormous scale of the transitions needed. In developed countries, knowledge on how to create the most suitable legal environment for adaptation has to grow as well. It seems that international cooperation and exchange of ideas and experiences would facilitate such a process.

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[117] D.L. Spittlehouse and Richard B. Stewart, "Adaptation to Climate Change in Forest Management", 4 *BC Journal of Ecosystems and Management* (2003), 1.

[118] Andrew Long, "Taking Adaptation Value Seriously: Designing REDD to Protect Biodiversity", 3 *Carbon and Climate Law Review* (2009), 314.